

课程详述

COURSE SPECIFICATION

以下课程信息可能根据实际授课需要或在课程检讨之后产生变动。如对课程有任何疑问，请联系授课教师。

The course information as follows may be subject to change, either during the session because of unforeseen circumstances, or following review of the course at the end of the session. Queries about the course should be directed to the course instructor.

1.	课程名称 Course Title	医用机器人 Medical Robotics
2.	授课院系 Originating Department	生物医学工程系 Biomedical Engineering
3.	课程编号 Course Code	BMEB330
4.	课程学分 Credit Value	3
5.	课程类别 Course Type	专业核心课 Major Core Courses
6.	授课学期 Semester	春季 Spring
7.	授课语言 Teaching Language	英文 English
8.	授课教师、所属学系、联系方式 Instructor(s), Affiliation & Contact (For team teaching, please list all instructors)	张明明, 生物医学工程系, 电子邮箱: zhangmm@sustech.edu.cn
9.	实验员/助教、所属学系、联系方式 Tutor/TA(s), Contact	待公布 To be announced
10.	选课人数限额(可不填) Maximum Enrolment (Optional)	30

11. 授课方式 Delivery Method	讲授 Lectures	习题/辅导/讨论 Tutorials	实验/实习 Lab/Practical	其它(请具体注明) Other (Please specify)	总学时 Total
学时数 Credit Hours	48				48
12. 先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	线性代数 MA113				
13. 后续课程、其它学习规划 Courses for which this course is a pre-requisite	无 None				
14. 其它要求修读本课程的学系 Cross-listing Dept.	无 None				

教学大纲及教学日历 SYLLABUS

15. 教学目标 Course Objectives

医用机器人是智能医学工程专业学生的必修课程之一，我们将学习医用机器人种类、功能及临床应用，机器人运动学和动力学，机器人运动及交互控制，并结合具体案例了解医用机器人的开发原理和思路。本课程面向智能医学工程、生物医学工程、机器人工程、计算机科学与技术等专业的大三/四本科生和研究生，不需要系统的医学背景。

Medical robotics is one of the compulsory courses for students majoring in intelligent medical engineering. In this course, we will learn the classification, function and clinical application of medical robots, robot kinematics and dynamics, robot motion and interaction control, and understand the development principles and ideas of medical robots based on specific cases. This course is open to junior/senior undergraduate and graduate students majoring in Intelligent Medical Engineering, Biomedical Engineering, Mechanical Engineering, Robotics Engineering, Computer Science and Technology, Electronic Science and Technology, etc. No professional medical background is required.

16. 预达学习成果 Learning Outcomes

- 1、了解医用机器人的种类、功能及临床应用情况；
- 2、掌握机器人运动学和动力学分析方法；
- 3、掌握机器人运动及交互控制实现方法；
- 4、理解医用机器人的开发思路及工作原理，并能进行简单医用机器人的开发。

1. Understand the types, functions and clinical applications of medical robots;
2. Master the kinematics and dynamics analysis methods of the medical robot;
3. Master basic control methods of robot motion and interaction;
4. Understand the development ideas and working principles of medical robots and be able to develop simple medical robots.

17. 课程内容及教学日历（如授课语言以英文为主，则课程内容介绍可以用英文；如团队教学或模块教学，教学日历须注明主讲人）

Course Contents (in Parts/Chapters/Sections/Weeks. Please notify name of instructor for course section(s), if this is a team teaching or module course.)

第一章 医用机器人绪论 Introduction to medical robotics (2 学时)

介绍医用机器人的种类、功能、关键技术与挑战, 以及临床应用情况等

To introduce the types of medical robots and their functions, key techniques and challenges, clinical applications.

第二章 医用机器人机构、驱动与感知 Medical robotics—Mechanism, actuation and perception (2 学时)

讲解医疗机器人常用机构、驱动器、及感知单元等

To introduce commonly used mechanisms, actuators and sensors in medical robots, etc.

第三章 医用机器人运动学 I Medical robotics—Kinematics I (4 学时)

讲解医用机器人的运动学, 主要包括并联机构的逆运动学和串联机构的正运动学等

To introduce kinematics of medical robots, including inverse kinematics of parallel mechanisms and forward kinematics of serial mechanisms, etc.

第四章 医用机器人运动学 II Medical robotics—Kinematics II (4 学时)

讲解医用机器人的运动学, 主要包括并联机构的逆运动学和串联机构的正运动学等

To introduce kinematics of medical robots, including inverse kinematics of parallel mechanisms and forward kinematics of serial mechanisms, etc.

第五章 医用机器人动力学 Medical robotics—Dynamics (4 学时)

讲解医用机器人的动力学, 比如构建驱动力/力矩与末端执行器力/力矩之间的映射关系等

To introduce dynamics of medical robots, such as developing the mapping relation between actuator force/torque and end effector force/torque, etc.

第六章 医用机器人运动控制 Medical robotics—Motion control (4 学时)

讲解医用机器人运动控制等

To introduce the motion control of medical robots, etc.

第七章 医用机器人交互控制 Medical robotics—Interactive control (4 学时)

讲解医用机器人交互控制的实现策略, 比如基于导纳原理的力交互控制和基于生理信号的交互控制等

To introduce different strategies for interactive control of medical robots, such as interactive force control based on admittance, etc.

第八章 医用机器人触觉控制 Medical robotics—Haptic control (4 学时)

讲解医用机器人中触觉控制的实现原理和方法等

To introduce the principle and methods for haptic display of medical robots, etc.

第九章 人体运动及力学分析 Human motion and sports biomechanics (4 学时)

讲解人体运动及力学的基本原理、仿真、及分析方法等

To introduce human motion, simulation, and analysis of sports biomechanics, etc.

第十章 医用机器人案例分析 I Medical robotics—Case study I (4 学时)

讲解任务导向性康复机器人原理、设计、控制、及人机交互等

To introduce the idea behind task-oriented rehabilitation robotics, as well as the design, control, human-robot interaction, etc.

第十一章 医用机器人案例分析 II Medical robotics—Case study II (4 学时)

讲解行走辅助机器人原理、设计、控制、及人机交互等

To introduce the idea behind walking-assisted robotics, as well as the design, control, human-robot interaction, etc.

第十二章 医用机器人创新设计或实践展示 Presentation on novel medical robotic design or practice (6 学时)

同学分享医用机器人的创新设计理念及思路或实践展示, 并进行课堂互动交流等

Students share innovative design and ideas of medical robots or practice demonstration, and conduct classroom interaction and exchange, etc.

第十三章 课程总结与评估 Course summary and assessment (2 学时)

总结本课程的教学重点、难点、并进行课程评估等

Summarize the teaching key and difficult points of this course and conduct course evaluation, etc.

18. 教材及其它参考资料 Textbook and Supplementary Readings

1. Introduction to Robotics: Mechanics and Control, John Craig 著, 2017, Pearson, 3rd or 4th edition
2. Stanford University, ME 328: Medical Robotics, <http://web.stanford.edu/class/me328/>
3. Massachusetts Institute of Technology, Introduction to Robotics, <https://ocw.mit.edu/courses/mechanical-engineering/2-12-introduction-to-robotics-fall-2005/lecture-notes/>

课程评估 ASSESSMENT

19. 评估形式 Type of Assessment	评估时间 Time	占考试总成绩百分比 % of final score	违纪处罚 Penalty	备注 Notes
出勤 Attendance		10%		
课堂表现 Class Performance				
小测验 Quiz		10%		
课程项目 Projects		40%		
平时作业 Assignments				
期中考试 Mid-Term Test				
期末考试 Final Exam		40%		
期末报告 Final Presentation				
其它 (可根据需要 改写以上评估方式) Others (The above may be modified as necessary)				

20. 记分方式 GRADING SYSTEM

- A. 十三级等级制 Letter Grading
 B. 二级记分制 (通过/不通过) Pass/Fail Grading

课程审批 REVIEW AND APPROVAL

- 21. 本课程设置已经过以下责任人/委员会审议通过
This Course has been approved by the following person or committee of authority**

生物医学工程系教学委员会